Modelling and Simulation

Programme course

6 credits

Modellbygge och simulering

TNG022

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Electrical Engineering, Media Technology and Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Electronics Design Engineering, M Sc in Engineering
- Communication and Transportation Engineering, M Sc in Engineering
- Media Technology and Engineering, M Sc in Engineering

Specific information
The course include a part of the syllabus block "oral and written communication in english"

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Statistics and Probability, Automatic Control, Basic Technical English.

Intended learning outcomes

The course aims at providing knowledge of methods and principles for building mathematical models for dynamic systems. Model construction from physical principles as well as from measurement data is covered. Properties of models are also studied by means of simulation. After completed course the student should be able to:

- define, describe and apply basic concepts related to modelling, identification and simulation.
- simplify a given model using static relations, substitution of variables using constants, neglection of small effects and aggregation of states.
- using conservation laws and constitutive relationships and other physical relations to model mechanical (in one dimension), electrical and flow systems, and combinations of these, in DAE form and (if possible) in state space representation.
- contruct bond graphs for the type of systems mentioned above, simplify and analyze the bond graph according to causality conflicts, and from a given bond graph without conflicts make a state space representation.
- calculate the index of a given DAE.
- model and simulate mechanical (in one dimension) and electrical systems using the computer tools Simulink and 20Sim.
- identify a model of a real system by choosing experiment setup, post processing of data, model structure and validation.
- calculate asymptotic bias and variance properties of a given linear identification problem.
- decide if a give simulation method is implicit or explicit and how many steps it consists of, and calculation of the local and global error and stability area for simple simulation methods.
- Oral and written communication Technical English

Course content

Models and the model concept. Differential equations, difference equations. Description of statistical dynamical properties. Physically based equations for model building: energy balance, mass flow balance, Newtons laws of movement, etc. General principles for model building. Bond graphs. Model reduction. Differential algebraic equations. Identification of dynamic systems: methods to build models based om measurement data from processes. Blackbox models. Parametric estimation in linear dynamic models. System identification as model building tool. Model validation. Simulation: numeric accuracy and stability. The simulation language Simulink. To write report in English

Teaching and working methods

The course consists of lectures, tutorials and laboratory sessions
The course include a part of the syllabus block "oral and written communication in english" for ED, KTS and MT.

Examination

UPG1	Written report, oral presentation and opposition in English	1 credits	U, G
LAB2	Laboratory work	1 credits	U, G
TEN2	Written examination	4 credits	U, 3, 4, 5

Written report in English on laboratory work is a part of examination.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Department

Institutionen för teknik och naturvetenskap

Director of Studies or equivalent

Adriana Serban

Examiner

Anna Lombardi

Course website and other links

http://www2.itn.liu.se/utbildning/kurs/

Education components

Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

Additional literature

Books

L. Ljung och T. Glad, (2004) *Modellbygge och simulering*
Studentlitteratur
L. Ljung och T. Glad, (1997) *Modellbygge och simulering, Övningsbok*
Studentlitteratur

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.